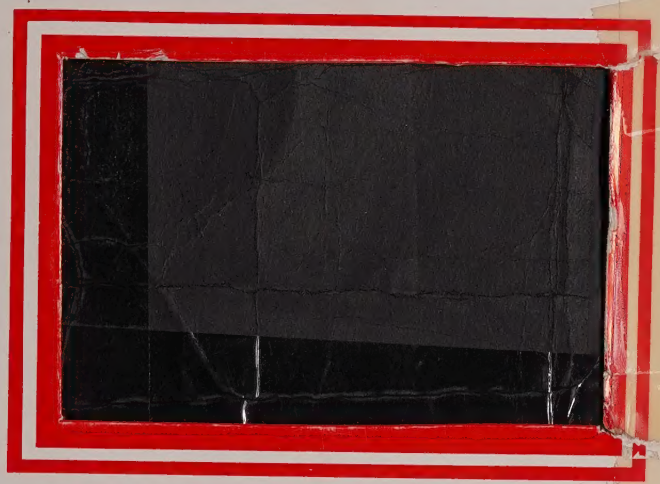
1379

C-574

METROLOGY GROUP

TEST EQUIPMENT DESIGN



Electronic Services - Los Angeles
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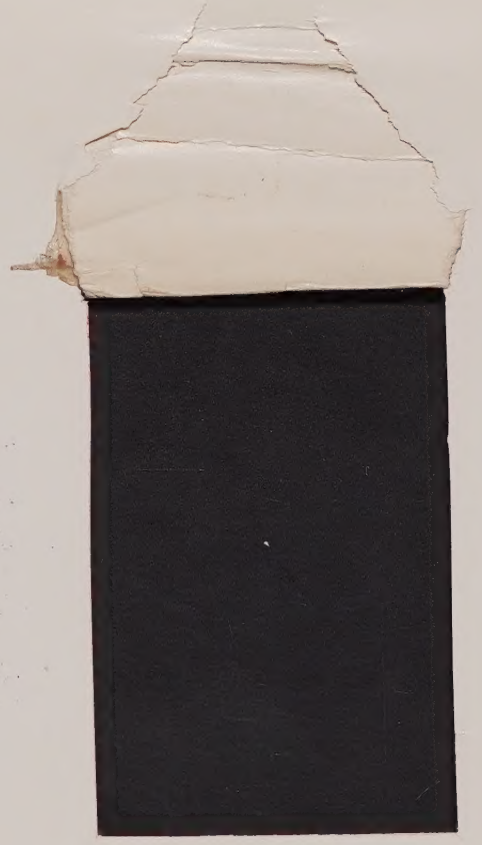
NEMS CLARKE CO.

919 JESUP BLAIR DRIVE • SILVER SPRING, MARYLAND

A DIVISION OF Vitro CORPORATION OF AMERICA



ZEUS
1379

INSTRUCTION BOOK

FOR

MC-216

MULTICOUPLER

ZEUS
MISSILE
C-574
TEST EQUIPMENT DESIGN

FEB 24 1959

NEMS-CLARKE COMPANY
919 Jesup-Blair Drive
Silver Spring, Maryland
A Division of Vitro Corporation of America

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WARNING

This equipment employs voltages which are dangerous and may be fatal if contacted by operating personnel. Maintenance personnel are urged to use extreme caution when operating the equipment with any of the protective covers removed.

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PERFORMANCE SPECIFICATIONS

Pass Band	225 to 260 mc.
Uniformity of Response	Within 3 db.
Gain	Approximately unity.
Impedance	Designed to operate in 50 ohm system.
Receiver Outputs	Six
Isolation	37 db minimum
Power Requirement	15 watts
Power Source	117 volts, 50 to 400 cycles, single phase, alternating current.
Dimensions	7" x 19" x 10"
Finish	Gray enamel MIL-E-15090-color #2640. per federal spec. TT-C-595

SEMI- CONDUCTOR AND TUBE COMPLEMENT

Symbol	Type	Function
CR-101	126-581-AQC	Full wave Bridge Rectifier
V-101	5842/417A	First RF Amplifier
V-102	5842/417A	Second RF Amplifier

MC 214

TABLE 1-1. Performance Specifications and Semi-Conductor and Tube Complement.

SECTION 1

GENERAL DESCRIPTION

1. PURPOSE OF EQUIPMENT.

The NEMS-CLARKE CO. Model MC-216 Multicoupler has been specifically designed for use with the NEMS-CLARKE Co, preamplifiers and telemetry receivers. When used with a suitable preamplifier and telemetry receivers, the MC-216 Multicoupler will provide a sensitive receiving system that allows the operation of up to six receivers from the same antenna without noticeable interaction. The noise figure of the system is essentially that of the preamplifier and consequently a preamplifier with high gain and low noise figure must be used if the system is to operate adequately. A 200 series NEMS-CLARKE CO. preamplifier is recommended. Passive linear dividing networks are used in the multicoupler, thus eliminating the cross talk and distortion usuzlly associated with vacuum tube multicouplers, and assuring a high degree of isolation between receiver outputs. Only two tubes are used in the MC-216 Multicoupler, assuring a high degree of reliability.

2. DESCRIPTION OF EQUIPMENT.

The Model MC-216 Multicoupler dimensions are 7 inches high, by 19 inches wide, by 10 inches deep, making the unit suitable for mounting in a standard 19 inch relay rack. The Model MC-216 weighs approximately 14 lbs.

The panel and chassis is of aluminum construction, and the panel is finished in Gray Enamel per MIL-E-15090, color #2640 per federal spec TT-C-595. Figure 1-1 shows a front view of the Model MC-216, Table 1-1 shows the Performance Specifications, and Semi-Conductor and Tube Complement.

SECTION 2

THEORY OF OPERATION

1. ANALYSIS, MODEL MC-216 MULTICOUPLER.

The MC-216 Multicoupler consists of two RF amplifiers that feed a six-output resistive network that divides the signal in such a way as to provide six independent receiver outputs. The passband of the multicoupler is from 225 to 260 mc, and has a uniformity of response within this band of within 3.0 db. The gain of the multicoupler is approximately unity, and the isolation between receiver outputs is a minimum of 27 db. The Multicoupler operates from a nominal power source of 117 volts, 50 to 60 and 400 cycles, single phase, alternating current. A block diagram of the model MC-216 multicoupler is shown in Figure 2-1.

2. DETAILED THEORY .

a. First RF Amplifier, V-101.-- The signal from the preamplifier is applied to input jack, J-108, on the rear apron of the multicoupler, through the blocking capacitor, C-101, across inductor L-102, to the cathode of the grounded grid 5842/417A First RF Amplifier, V-101. Cathode resistor method of obtaining self bias is used in this amplifier, cathode resistor, R-101, developing the bias, and the capacitor, C-102, providing cathode resistor bypassing. The plate load for the First RF Amplifier consists of self resonant series inductor, L-105, coupling inductor, L-107, and the series tuned circuit, consisting of L-106 and C-105. This plate load forms a modified "T" network that serves to match the relatively high-impedance of the plate circuit of the First RF Amplifier plate circuit to the low input impedance of the cathode of the following stage. This network also serves as a bandpass filter to provide the proper interstage response. The RC combination of R-102 and C-104 act as a plate decoupling network.

b. Second RF Amplifier, V-102.-- The signal from the modified "T" interstage network is applied to the cathode of the Second RF Amplifier through the capacitor, C-106, and across inductor, L-103. Cathode resistor method of obtaining self-bias is used in this amplifier, the resistor, R-103, developing the bias, and capacitor, C-107, providing cathode resistor bypassing. The plate load of the Second RF Amplifier consists of the coupling inductor, L-104, blocking capacitor, C-109, center-tapped inductor, L-108, and the resistive coupling networks that feed the various receivers. The reactive section of the plate load acts as a bandpass filter to assure the proper overall response, and sufficient bandwidth to cover the entire bandpass of 225 to 260 mc. The resistive section of the plate load assures a constant load on the Second RF Amplifier irrespective of the number of receivers operated from the multicoupler.

c. Resistive Outputs to Receivers.-- Six resistive terminations are used to match the output of the Second RF Amplifier to the coaxial transmission line that feeds the input of the receivers used with the Model MC-216 Multicoupler. Each network consists of four resistors in a modified pi-network, that assures a minimum of 37 db isolation between receiver outputs, and at the same time maintains a constant 50 ohm output impedance. Variations in load on the plate circuit of the Second RF Amplifier are thereby minimized, and a constant output is guaranteed.

d. Power Supply.-- Power input required for operation of the Model MC-216 Multicoupler is 117 volts, 50 to 400 cycles, alternating current, and is applied to the plug P-115 on the rear apron of the unit. A pilot-lamp, I-101, indicates when power is applied. The switch S-101, when closed, activates the primary circuit of the power transformer, T-101, through the fuse, F-101. High voltage AC is taken from the secondary of the transformer from terminals #3 and #4 and applied to the full-wave bridge rectifier, CR-101.

The pulsating DC which results is filtered by a conventional capacitive input IC filter for DC supply. Filament voltage for the two tubes is supplied from terminals #5 and #6 on the power transformer, T-101.

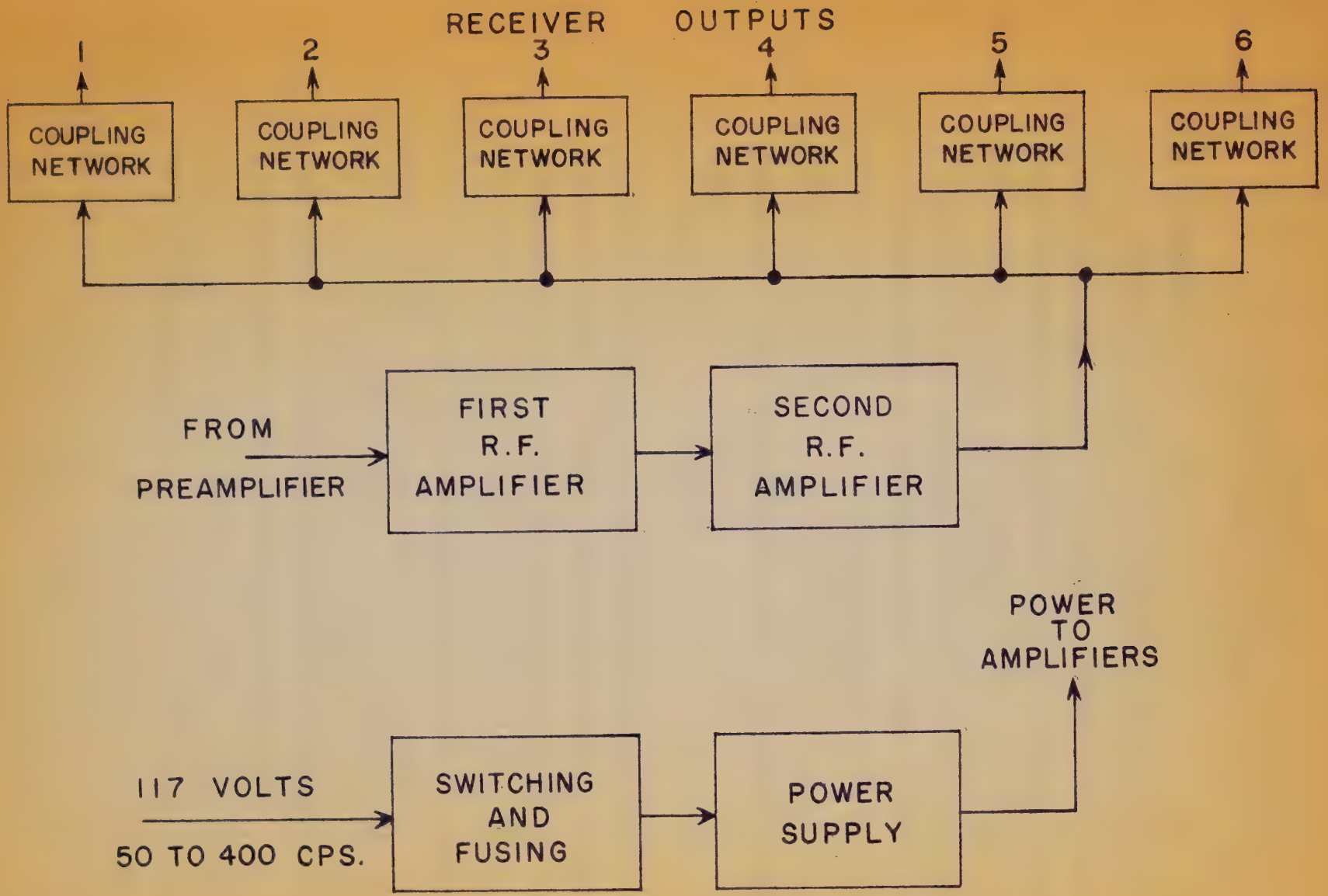


FIG. 2-1. BLOCK DIAGRAM, MODEL MC-216 MULTICOUPLER.

SECTION 3

INSTALLATION AND OPERATION

1. INTRODUCTION.

The shipping container for the Model MC-216 RF Multicoupler consists of an inner and outer corrugated container, with the necessary padding to assure that the unit is not damaged in shipping. When unpacking the unit, great care must be taken that crowbars or other sharp instruments do not come into contact with the equipment, as this may damage the finished surfaces or external components. After unpacking, the unit should be thoroughly inspected for loose or broken components due to rough handling in shipping. As received by the purchases the unit is completely assembled and ready for operation inasmuch as all internal connections are complete.

2. INSTALLATION.

After unpacking the unit, mount it in the rack in which it is intended to operate. All internal connections are complete, and the only connections the purchaser must make are those to the associated equipment, and to the power mains. This may be accomplished by the following procedure:

a. Connect the 50 ohm cable, from the associated preamplifier, to the input jack, J-108, on the rear apron of the MC-216.

b, Connect the receiver or receivers, to be operated from the multicoupler, to the output connectors, J-109 through J-114, on the rear apron of the MC-216 using 50 ohm coaxial transmission line.

c. Apply 117 volts, 50 to 400 cycles, single phase, alternating current to the power input plug, P-115, on the rear apron of the unit.

3. OPERATION.

After the unit is installed in accordance with the above instructions, operation consists of placing all associated equipment in operation, and then turning the power switch on the front panel of the MC-216 to "ON". This applies power to the Multicoupler and approximately 30 seconds after the application of power, the unit is ready for operation.

SECTION 4

MAINTENANCE

1. INTRODUCTION.

The Model MC-216 Multicoupler has been fully aligned and factory tested before shipment and should give ling and trouble free performance. In the event that trouble is encountered, a logical effect-to-cause reasoning process should enable the technician to localize the trouble and effect rapid and efficient repairs with a minimum of lost time. Experience has shown that the most common type of failure or misfunction is caused by a defective or non operational electron tube. Replacement of the tubes in the MC-216 may cause the alignment of the unit to change, thus necessitating realignment. Should this occur, the following procedure will rpove to be of value in effecting realignment:

2. ALIGNMENT PROCEDURE.

a. Equipment Required for Alignment:

(1) Marker Generator, Measurements Corp. Model 80, or equivalent.

(2) Oscilloscope, Dumont, Model 304A or equivalent.

(3) Sweep Generator, RCA Model WR-59C, modified for General coverage to 260 mc.

(4) Output detector for alignment, see Figure 4-1.

(5) Balun for alignment, See Figure 4-2.

(6) Assorted 50 ohm cables, connectors, and alligator clips.

b. Alignment.

(1) Connect the Balun (see Figure 4-2) to the input of the multicoupler at jack, J-108.

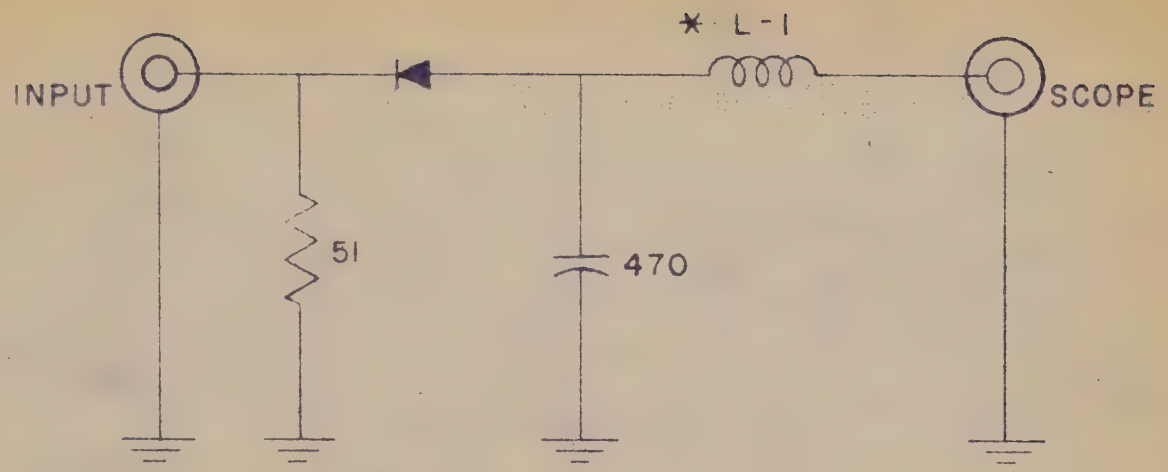
(2) Connect the sweep generator and marker generator to the input of the Balun. Use maximum output from the sweep generator.

(3) Connect the output detector (see Figure 4-1) into one of the six output connectors, J-109, through J-114.

(4) Connect the vertical input of the oscilloscope to the output of the detector.

(5) Adjust the interstage primary inductor, L-105, the secondary inductor, L-106, and the coupling inductor, L-107, until an overcoupled response is obtained with a peak-to-peak separation of 34 mc, centered at 245 mc.

(6) Adjust the variable slug and the variable tap position on inductor L-108, for an overall response with peaks at 228 and 262 mcs, and a 5% dip at 245 mcs. Note: The length and position of the turns on inductor, L-108, particularly between the tap and ground, affect the dip at the center frequency of 245 mcs, and will probably have to be adjusted to obtain the correct response pattern. The dip tolerance is from 5% to 10%.



* L-1, WIND 32 HF WIRE ON SPEER TYPE CFB-107 COIL FORM UNTIL FULL.

FIG. 4-1 SCHEMATIC DIAGRAM, OUTPUT DETECTOR FOR ALIGNMENT.

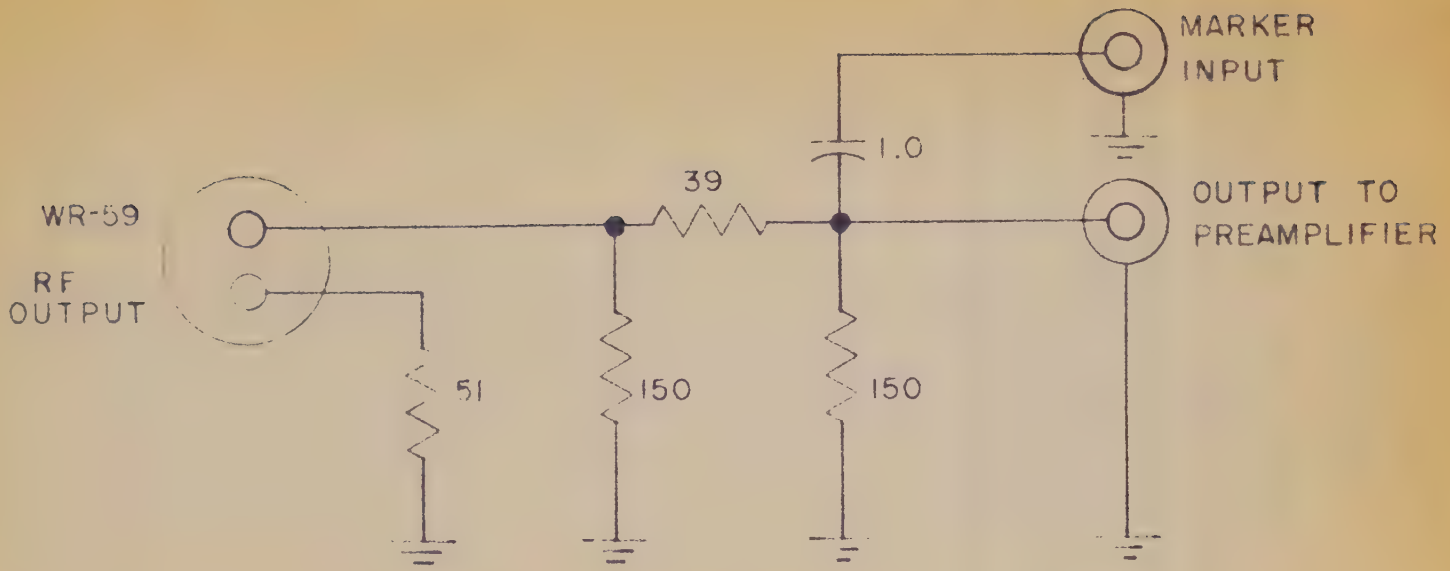


FIG. 4-2 SCHEMATIC DIAGRAM, BALANCED TO UNBALANCED 6 db ATTENUATOR (BALUN), FOR ALIGNMENT.

SECTION 5

PARTS LIST MODEL MC-216

MULTICOUPLER

When ordering replacement parts, give the equipment name and model number, the symbol number and a complete description of each item ordered.

Replacement parts which will be supplied against an order may not be exact duplicates of the original parts, However, only minor differences in the electrical or mechanical characteristics will be involved, and, consequently, will in no way impair the operation of the equipment.

SECTION 5

PARTS LIST MODEL MC-216

MULTICOUPLER

Symbol Number	Name of Part and Description
C-101	CAPACITOR, CERAMIC: 470 μμf ±10%, Erie type NPO-A.
C-102	CAPACITOR, CERAMIC: standoff, .001 mfd, Sprague Type 507C2.
C-103	CAPACITOR, CERAMIC: disc, .001 mfd, Sprague type 40C320A.
C-104	Same as C-102.
C-105	Not used.
C-106	CAPACITOR, CERAMIC: 2.2 μμf, .25 μμf, Erie type NPO-A.
C-107	Same as C-102.
C-108	Same as C-103.
C-109	Same as C-101.
C-110	Same as C-102.
C-111	CAPACITOR, ELECTROLYTIC; bathtub, 4 mfd, 400V, Astron MD-4-4M.
C-112	Same as C-111.
BR-101	RECTIFIER, selenium; 126-581-AQC, Sarked-Tarzian M-500.
J-101	CONNECTOR, RECEPTACLE: UG-1094/U
J-102	Same as J-101.
J-103	Same as J-101.
J-104	Same as J-101.
J-105	Same as J-101.
J-106	Same as J-101.
J-107	Same as J-101.
J-108	CONNECTOR, RECEPTACLE, UG-704/U
J-109	Same as J-108.

SECTION 5

MODEL MC-216

MULTICOUPLER

Symbol Number	Name of Part and Description
J-110	Same as J-108.
J-111	Same as J-108.
J-112	Same as J-108.
J-113	Same as J-108.
J-114	Same as J-108.
L-101	INDUCTOR, FILTER: 15 hy, 40 ma, Chicago Transformer #RH-1540.
L-102	INDUCTOR: per NEMS-CLARKE Co. Dwg. #A-17,422.
L-103	Same as L-102.
L-104	Same as L-102.
L-105	INDUCTOR: per NEMS-CLARKE Co. Dwg. # A-17,423-4.
L-106	INDUCTOR: per NEMS-CLARKE Co. Dwg. #A-18,476.
L-107	INDUCTOR: per NEMS-CLARKE Co. Dwg. #AD-17,462-49
L-108	INDUCTOR: per NEMS-CLARKE Co. Dwg. #A-17,425-2.
P-101	CONNECTOR, PLUG: type UG-88/U.
P-102	Same as P-101.
P-103	Same as P-101.
P-104	Same as P-101.
P-105	Same as P-101.
P-106	Same as P-101.
P-107	Same as P-101.
P-108	Same as P-101.
P-109	Same as P-101.
R-101	RESISTOR, COMPOSITION; fixed, 68 ohms, ±5%, 1/2W, Allen Bradley #EB-6805.
R-102	RESISTOR, COMPOSITION: fixed, 3K ohms, ±5%, 1/2W, Allen Bradley HB-3025.

SECTION 5

MODEL MC-216

MULTICOUPLER

Symbol Number	Name of Part and Description
R-103	Same as R-101.
R-104	Same as R-102.
R-105	RESISTOR, COMPOSITION: fixed, 150K ohm ±10%, 1W, Allen Bradley GB-1511.
R-106	RESISTOR, COMPOSITION: fixed, 75 ohm ±5%, 1/2W, Allen Bradley EB-7505.
R-107	Same as R-106.
R-108	RESISTOR, COMPOSITION: fixed, 100 ohms, ±5%, 1/2W, Allen Bradley EB-1015.
R-109	Same as R-106.
R-110	Same as R-106.
R-111	Same as R-106.
R-112	Same as R-108.
R-113	Same as R-106.
R-114	Same as R-106.
R-115	Same as R-106.
R-116	Same as R-108.
R-117	Same as R-106.
R-118	Same as R-106.
R-119	Same as R-106.
R-120	Same as R-108.
R-121	Same as R-106.
R-122	Same as R-106.
R-123	Same as R-106.

SECTION 5

MODEL MC-216

MULTICOUPLER

Symbol Number	Name of Part and Description
R-124	Same as R-108.
R-125	Same as R-106.
R-126	Same as R-106.
R-127	Same as R-106.
R-128	Same as R-108.
R-129	Same as R-106.
T-101	TRANSFORMER, POWER: per NEMS-CLARKE Dwg. #AB-17,419.
V-101	TUBE, ELECTRON: 5842/417A.
V-102	TUBE, ELECTRON: 5842/417A.
XV-101	SOCKET, ELECTRON TUBE: Mycalex #90A299.
XV-102	SOCKET, ELECTRON TUBE: Mycalex #90A299.